This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

---

1. Simplify the expression below and choose the interval the simplification is contained within.

$$13 - 4^2 + 11 \div 17 * 15 \div 10$$

The solution is -2.029, which is option B.

A. $[29.43, 30.3]$

29.971, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

B. $[-2.83, -1.86]$

* -2.029, this is the correct option

C. $[-3.87, -2.33]$

-2.996, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[28.66, 29.69]$

29.004, which corresponds to two Order of Operations errors.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

2. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{-2160}{9}}$$

The solution is Not a Real number, which is option B.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

B. Not a Real number

* This is the correct option!

C. Irrational

These cannot be written as a fraction of Integers.

D. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

E. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{240}i$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

3. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{9 - 77i}{8 - 6i}$$

The solution is $5.34 - 5.62i$, which is option C.

A. $a \in [533, 535]$ and $b \in [-6.5, -4.5]$

$534.00 - 5.62i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-4.5, -2.5]$ and $b \in [-8, -6]$

$-3.90 - 6.70i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [4.5, 6.5]$ and $b \in [-6.5, -4.5]$

* $5.34 - 5.62i$, which is the correct option.

D. $a \in [1, 2.5]$ and $b \in [12, 14]$

$1.12 + 12.83i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [4.5, 6.5]$ and $b \in [-562.5, -561]$

$5.34 - 562.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(4 - 9i)(-2 - 10i)$$

The solution is $-98 - 22i$, which is option D.

A. $a \in [79, 87]$ and $b \in [56, 62]$

$82 + 58i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-16, -7]$ and $b \in [88, 93]$

$-8 + 90i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C. $a \in [-99, -94]$ and $b \in [19, 23]$

$-98 + 22i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-99, -94]$ and $b \in [-24, -21]$

* $-98 - 22i$, which is the correct option.

E. $a \in [79, 87]$ and $b \in [-64, -57]$

$82 - 58i$, which corresponds to adding a minus sign in the first term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

5. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{0}{15}} + \sqrt{4}i$$

The solution is Pure Imaginary, which is option D.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

B. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Pure Imaginary

* This is the correct option!

E. Nonreal Complex

This is a Complex number ($a + bi$) that is not Real (has i as part of the number).

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

6. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-8 + 5i)(-9 - 7i)$$

The solution is $107 + 11i$, which is option C.

A. $a \in [31, 44]$ and $b \in [98, 104]$

$37 + 101i$, which corresponds to adding a minus sign in the first term.

B. $a \in [65, 78]$ and $b \in [-37, -29]$

$72 - 35i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C. $a \in [107, 110]$ and $b \in [11, 15]$

* $107 + 11i$, which is the correct option.

D. $a \in [107, 110]$ and $b \in [-15, -7]$

$107 - 11i$, which corresponds to adding a minus sign in both terms.

E. $a \in [31, 44]$ and $b \in [-101, -99]$

$37 - 101i$, which corresponds to adding a minus sign in the second term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

7. Simplify the expression below and choose the interval the simplification is contained within.

$$5 - 13 \div 19 * 7 - (20 * 4)$$

The solution is -79.789, which is option D.

A. $[84.7, 85.14]$

84.902, which corresponds to not distributing addition and subtraction correctly.

B. $[-79.27, -77.74]$

-79.158, which corresponds to not distributing a negative correctly.

C. $[-75.97, -73.49]$

-75.098, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[-80.42, -79.52]$

* -79.789, which is the correct option.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

8. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{-1575}{15}} + \sqrt{60}$$

The solution is Nonreal Complex, which is option B.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

B. Nonreal Complex

* This is the correct option!

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

E. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

9. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-36 - 77i}{-1 + 6i}$$

The solution is $-11.51 + 7.92i$, which is option E.

A. $a \in [-428, -425.5]$ and $b \in [6, 8.5]$

$-426.00 + 7.92i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [13, 14.5]$ and $b \in [-4.5, -3]$

$13.46 - 3.76i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [-12.5, -11]$ and $b \in [292.5, 294]$

$-11.51 + 293.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [35, 37.5]$ and $b \in [-13.5, -12.5]$

$36.00 - 12.83i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-12.5, -11]$ and $b \in [6, 8.5]$

* $-11.51 + 7.92i$, which is the correct option.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

10. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{-525}{5}}$$

The solution is Not a Real number, which is option B.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Not a Real number

* This is the correct option!

C. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

E. Irrational

These cannot be written as a fraction of Integers.

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{105}i$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

11. Simplify the expression below and choose the interval the simplification is contained within.

$$4 - 20^2 + 2 \div 6 * 16 \div 7$$

The solution is -395.238, which is option A.

A. $[-395.45, -394.63]$

* -395.238, this is the correct option

B. $[403.57, 404.34]$

404.003, which corresponds to two Order of Operations errors.

C. $[-396.71, -395.71]$

-395.997, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[404.69, 404.85]$

404.762, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

12. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{576}{49}}$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

C. Irrational

These cannot be written as a fraction of Integers.

D. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

E. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\frac{24}{7}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

13. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{54 + 44i}{-1 + 5i}$$

The solution is $6.38 - 12.08i$, which is option D.

A. $a \in [-55.5, -53]$ and $b \in [8.74, 8.84]$

$-54.00 + 8.80i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [6, 7.5]$ and $b \in [-314.01, -313.96]$

$6.38 - 314.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [165, 167]$ and $b \in [-12.08, -12.05]$

$166.00 - 12.08i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [6, 7.5]$ and $b \in [-12.08, -12.05]$

* $6.38 - 12.08i$, which is the correct option.

E. $a \in [-11, -10]$ and $b \in [8.65, 8.71]$

$-10.54 + 8.69i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

14. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-10 + 2i)(-4 + 3i)$$

The solution is $34 - 38i$, which is option A.

A. $a \in [34, 36]$ and $b \in [-44, -34]$

* $34 - 38i$, which is the correct option.

B. $a \in [42, 50]$ and $b \in [-25, -21]$

$46 - 22i$, which corresponds to adding a minus sign in the first term.

C. $a \in [34, 36]$ and $b \in [34, 39]$

$34 + 38i$, which corresponds to adding a minus sign in both terms.

D. $a \in [38, 42]$ and $b \in [-9, 10]$

$40 + 6i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

E. $a \in [42, 50]$ and $b \in [17, 27]$

$46 + 22i$, which corresponds to adding a minus sign in the second term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

15. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{-1815}{11}} + \sqrt{0}i$$

The solution is Pure Imaginary, which is option B.

A. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

B. Pure Imaginary

* This is the correct option!

C. Nonreal Complex

This is a Complex number ($a + bi$) that is not Real (has i as part of the number).

D. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

E. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

16. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-2 + 8i)(5 + 7i)$$

The solution is $-66 + 26i$, which is option C.

A. $a \in [-68, -63]$ and $b \in [-26.15, -24.4]$

$-66 - 26i$, which corresponds to adding a minus sign in both terms.

B. $a \in [46, 49]$ and $b \in [53.91, 54.51]$

$46 + 54i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-68, -63]$ and $b \in [25.99, 27.39]$

* $-66 + 26i$, which is the correct option.

D. $a \in [-18, -5]$ and $b \in [55.28, 56.57]$

$-10 + 56i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

E. $a \in [46, 49]$ and $b \in [-54.41, -53.76]$

$46 - 54i$, which corresponds to adding a minus sign in the first term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

17. Simplify the expression below and choose the interval the simplification is contained within.

$$18 - 12^2 + 7 \div 8 * 13 \div 16$$

The solution is -125.289, which is option A.

A. $[-125.62, -124.54]$

* -125.289, this is the correct option

B. $[-126.26, -125.96]$

-125.996, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[161.86, 162.42]$

162.004, which corresponds to two Order of Operations errors.

D. $[162.05, 162.91]$

162.711, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

18. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{2}{-11} + 81i^2$$

The solution is Rational, which is option C.

A. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

B. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

C. Rational

* This is the correct option!

D. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

E. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

19. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{63 + 22i}{-5 - i}$$

The solution is $-12.96 - 1.81i$, which is option A.

A. $a \in [-13.39, -12.83]$ and $b \in [-3, -1]$

* $-12.96 - 1.81i$, which is the correct option.

B. $a \in [-13.39, -12.83]$ and $b \in [-48, -45]$

$-12.96 - 47.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-12.9, -12.46]$ and $b \in [-23.5, -21.5]$

$-12.60 - 22.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-337.01, -336.76]$ and $b \in [-3, -1]$

$-337.00 - 1.81i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [-11.33, -11.17]$ and $b \in [-8.5, -6]$

$-11.27 - 6.65i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

20. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{-990}{5}}$$

The solution is Not a Real number, which is option E.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

C. Irrational

These cannot be written as a fraction of Integers.

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

E. Not a Real number

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{198}i$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

21. Simplify the expression below and choose the interval the simplification is contained within.

$$15 - 20 \div 7 * 13 - (11 * 14)$$

The solution is -176.143, which is option B.

A. $[-140.22, -134.22]$

-139.220, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[-181.14, -174.14]$

* -176.143, which is the correct option.

C. $[168.78, 170.78]$

168.780, which corresponds to not distributing addition and subtraction correctly.

D. $[-466, -460]$

-464.000, which corresponds to not distributing a negative correctly.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

22. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{9025}{361}}$$

The solution is Integer, which is option B.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Integer

* This is the correct option!

C. Irrational

These cannot be written as a fraction of Integers.

D. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

E. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to -95.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

23. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-54 + 88i}{3 - 4i}$$

The solution is $-20.56 + 1.92i$, which is option E.

A. $a \in [-514.5, -513.5]$ and $b \in [1.5, 2.5]$

$-514.00 + 1.92i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [7, 8.5]$ and $b \in [19, 20]$

$7.60 + 19.20i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [-19, -17]$ and $b \in [-22.5, -21.5]$

$-18.00 - 22.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-21.5, -19.5]$ and $b \in [47.5, 48.5]$

$-20.56 + 48.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [-21.5, -19.5]$ and $b \in [1.5, 2.5]$

* $-20.56 + 1.92i$, which is the correct option.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

24. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(9 - 8i)(-4 + 3i)$$

The solution is $-12 + 59i$, which is option C.

A. $a \in [-65, -55]$ and $b \in [-5, -2]$

$-60 - 5i$, which corresponds to adding a minus sign in the first term.

B. $a \in [-40, -27]$ and $b \in [-28, -19]$

$-36 - 24i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C. $a \in [-15, -5]$ and $b \in [57, 61]$

* $-12 + 59i$, which is the correct option.

D. $a \in [-65, -55]$ and $b \in [5, 6]$

$-60 + 5i$, which corresponds to adding a minus sign in the second term.

E. $a \in [-15, -5]$ and $b \in [-59, -56]$

$-12 - 59i$, which corresponds to adding a minus sign in both terms.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

25. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{-20}{2} + 49i^2$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

E. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

26. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(10 - 6i)(2 + 4i)$$

The solution is $44 + 28i$, which is option C.

A. $a \in [41, 47]$ and $b \in [-29, -25]$

$44 - 28i$, which corresponds to adding a minus sign in both terms.

B. $a \in [17, 23]$ and $b \in [-25, -18]$

$20 - 24i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C. $a \in [41, 47]$ and $b \in [24, 29]$

* $44 + 28i$, which is the correct option.

D. $a \in [-6, -1]$ and $b \in [50, 53]$

$-4 + 52i$, which corresponds to adding a minus sign in the first term.

E. $a \in [-6, -1]$ and $b \in [-53, -51]$

$-4 - 52i$, which corresponds to adding a minus sign in the second term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

27. Simplify the expression below and choose the interval the simplification is contained within.

$$6 - 12^2 + 2 \div 16 * 17 \div 13$$

The solution is -137.837, which is option A.

A. $[-137.91, -137.54]$

* -137.837, this is the correct option

B. $[149.66, 150.07]$

150.001, which corresponds to two Order of Operations errors.

C. $[150.15, 150.24]$

150.163, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

D. $[-138.24, -137.98]$

-137.999, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

28. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$-\sqrt{\frac{324}{625}} + 25i^2$$

The solution is Rational, which is option E.

A. Pure Imaginary

This is a Complex number $(a+bi)$ that **only** has an imaginary part like $2i$.

B. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Nonreal Complex

This is a Complex number $(a+bi)$ that is not Real (has i as part of the number).

E. Rational

* This is the correct option!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

29. Simplify the expression below into the form $a+bi$. Then, choose the intervals that a and b belong to.

$$\frac{27-11i}{4+8i}$$

The solution is $0.25-3.25i$, which is option E.

A. $a \in [6.5, 8]$ and $b \in [-2, 0.5]$

$6.75-1.38i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-0.5, 0.5]$ and $b \in [-261.5, -258.5]$

$0.25-260.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [18.5, 20.5]$ and $b \in [-4, -2.5]$

$20.00-3.25i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [1.5, 3.5]$ and $b \in [1, 4.5]$

$2.45+2.15i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-0.5, 0.5]$ and $b \in [-4, -2.5]$

* $0.25-3.25i$, which is the correct option.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2+3i$, the conjugate is $2-3i$.

---

30. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{36}{529}}$$

The solution is Rational, which is option B.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Rational

* This is the correct option!

C. Irrational

These cannot be written as a fraction of Integers.

D. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

E. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\frac{6}{23}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.
